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Use and attitudes of obstetricians toward 3 high-risk interventions in MFMU Network hospitals

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Abstract

OBJECTIVE—We sought to evaluate the frequency of, and factors associated with, the use of 3 evidence-based interventions: antenatal corticosteroids for fetal lung maturity, progesterone for prevention of recurrent preterm birth, and magnesium sulfate for fetal neuroprotection.

STUDY DESIGN—A self-administered survey was conducted from January through May 2011 among obstetricians from 21 hospitals that included 30 questions regarding their knowledge, attitudes, and practice of the 3 evidence-based interventions and the 14-item short version of the Team Climate for Innovation survey. Frequency of use of each intervention was ascertained from an obstetrical cohort of women between January 2010 and February 2011.

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RESULTS—A total of 329 obstetricians (74% response rate) who managed 16,946 deliveries within the obstetrical cohort participated in the survey. More than 90% of obstetricians reported that they incorporated each intervention into routine practice. Actual frequency of administration in women eligible for the treatments was 93% for corticosteroids, 39% for progesterone, and 71%formagnesiumsulfate. Provider satisfaction with quality of treatment evidence was 97% for corticosteroids, 82% for progesterone, and 57% for magnesium sulfate. Obstetricians perceived that barriers to treatment were most frequent for progesterone (76%), 30% for magnesium sulfate, and 17% for corticosteroids. Progesterone use was more frequent among patients whose provider reported the quality of the evidence was above average to excellent compared with poor to average (42% vs 25%, respectively; $P < .001$), and they were satisfied with their knowledge of the intervention (41%vs 28%; $P = .02$), and was less common among patients whose provider reported barriers to hospital or pharmacy drug delivery (31% vs 42%; $P = .01$). Corticosteroid administration was more common among patients who delivered at hospitals with 24 hours a day–7 days a week maternal-fetal medicine specialist coverage (93% vs 84%; $P = .046$),

CONCLUSION—Obstetricians in Maternal-Fetal Medicine Units Network hospitals frequently use these evidence-based interventions; however, progesterone usewas found to be related to their assessment of evidence quality. Neither progesterone nor the other interventions were associated with overall climate of innovation within a hospital as measured by the Team Climate for Innovation. National Institutes of Health Consensus Conference Statements may also have an impact on use; there is such a statement for antenatal corticosteroids but not for progesterone for preterm prevention or magnesium sulfate for fetal neuroprotection.

Keywords

antenatal corticosteroids; evidence-based interventions; magnesium sulfate; Maternal-Fetal Medicine Units Network; progesterone

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The translation of research into clinical practice is influenced by numerous factors that may facilitate or hinder its translation, including the quality of the evidence, methods of disseminating results, presence or absence of consensus statements, attitudes and behaviors of physicians, hospital climate, and costs. In an effort to improve on the translation of research into practice, the National Institutes of Health (NIH) created the Roadmap for Medical Research in 2002.[1]

Traditional methods of disseminating information on new treatments in the obstetrical community include continuing education activities, lectures, and grand rounds. These methods have been described as ineffective at changing complex practices.[2] More recently it has been recognized that an organizational change, as well as individual provider knowledge, is needed to facilitate adoption of new treatments.[3] The climate (hospital and team), the user (provider), and the intervention itself interact and affect the implementation process.[4]

The *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) Maternal-Fetal Medicine Units (MFMU) Network, along with many other perinatal researchers, has provided evidence for therapies that aim to benefit pregnant women and their children. However, little is known about why some of the obstetrical

evidence that has been produced is adopted and why some is not. We set out to evaluate factors associated with the adoption trends of 3 evidence-based obstetrical interventions at different stages of implementation within the MFMU Network hospitals. The interventions studied were antenatal corticosteroids injections for fetal lung maturity, progesterone injections for the prevention of recurrent preterm birth, and intravenous magnesium sulfate for cerebral palsy prevention.

Antenatal corticosteroids

Treatment of women at risk of preterm delivery before 34 weeks with antenatal corticosteroids is a widely accepted practice. Liggins and Howie[5] first introduced this therapy in 1972. It was further supported by a metaanalysis in 1990[6] and an NIH Consensus Conference Statement in 1994.[7] This was followed by a second NIH Consensus Conference Statement in 2000[8] to make recommendations on repeat courses of antenatal steroids.

Notably, there have been 3 metaanalyses further disseminating information on this topic. Namely, the Cochrane Collaboration in 2006,[9] which was an extensive document to assess the effects of maternal antenatal corticosteroids on the mother, the fetus, the neonate, and the child; the Cochrane Collaboration in 2007,[10] which evaluated the effectiveness and safety of repeat courses of corticosteorids; and the Cochrane Collaboration in 2008,[11] which elaborated on the effects of various types and dosing regimens of corticosteroids.

Progesterone

Treating women who experienced a prior spontaneous delivery with progesterone in the current pregnancy has been studied over the past 3 decades. In 1975 Johnson et al[12] published one of the first randomized clinical trials on the topic and concluded that this therapy may be beneficial but that further studies and long-term follow-up are needed. In 2003, 2 major randomized clinical trials revealed further support for this treatment. Da Fonseca et al[13] published a report on the efficacy of vaginal progesterone in preventing recurrent preterm delivery, and Meis et al[14] published the MFMU Network trial of 17α-hydroxyprogesterone caproate injections, which showed a reduction in the risk of recurrent preterm deliveries.

Since then there have been several randomized clinical trials using various forms of progesterone delivery: vaginal gel,[15] oral micronized gelatin capsules,[16] vaginal micronized capsules,[17] vaginal suppositories,[18] and intramuscular agents,[19] all of which showed some benefit to this therapy. Several systematic review articles and metaanalyses similarly concluded a reduced risk of recurrent preterm delivery with the use of progestogens.[20-25] The American College Of Obstetricians and Gynecologists Committee Opinion in 2008[26] and subsequently the Practice Bulletin, Prediction and prevention of preterm birth,[27] further supported this practice based on the evidence.

Magnesium sulfate

In 1992 Kuban et al[28] published an epidemiological study to assess the perinatal risk factors associated with intraventricular hemorrhage in the newborn and found that mothers who

received magnesium sulfate had babies with a lower incidence of intraventricular hemorrhage. This was followed by a case-control study by Nelson and Grether[29] in 1995 showing that magnesium sulfate treatment is associated with a reduced risk of cerebral palsy among very low-birthweight infants.

Several observation studies were published since then, some showing benefit[30-35] and some negating the benefit.[36-43] These were followed by several randomized clinical trials[44-48] and subsequent systematic reviews with a metaanalysis of eligible trials,[49-51] which concluded that this therapy has a neuroprotective effect on the fetus. Despite additional support for this therapy from several clinical practice guideline documents and committee opinions,[52-56] the optimal regimen for balancing effectiveness and adverse effects to the mother and fetus remained unclear.[57]

Materials and Methods

A survey was conducted among obstetricians from January 2011 through May 2011 at 21 hospitals in the MFMU Network, and the survey data were linked to data abstracted from medical charts of deliveries occurring from January 2010 until February 2011, at the same 21 hospitals, of patients delivered by the survey responders. The online, self-administered survey included questions regarding the responder's knowledge of 3 obstetrical interventions, their satisfaction with the evidence, and the barriers to the use of these interventions.

The survey also included questions regarding the team climate at each hospital, ascertained using the validated 14 item short version of the Team Climate for Innovation (TCI) survey,[58] which is based on West and Farr's[59] 4 factor theory of group innovation with team activities.[60] The TCI survey has been used to predict success or failure of quality improvement strategies in several countries and industries. Ouwens et al[61] assessed the TCI survey in the health care industry among hospital teams and found it to be a valid, reliable, and discriminating self-report measure of team climate in hospital teams.

The 4 groups of questions in the TCI address vision (team members are committed to clear and realistic objectives), participative safety (team members interact in a participative and interpersonally nonthreatening climate), task orientation (team members are committed to high standards and are prepared for basic questions and apprised of weaknesses), and support for innovation (there is support for innovation attempts and cooperation to develop and apply new ideas).

To be eligible for the survey, providers had to be a general obstetrician or maternal-fetal medicine specialist and actively involved in patient deliveries at 1 of the 21 participating hospitals. Eligibility was ascertained from an obstetrical cohort (described below) of delivery data. The obstetrical cohort data were accessed to identify obstetrical providers who had a minimum of 5 deliveries in the cohort over a 6 month period (January 2010 through June 2010). From the initial list of 760 potentially eligible obstetricians, 467 providers were randomly chosen by the data coordinating center that assigned each a masked identification. These masked identifications along with a unique user name and password were

incorporated in a cover letter that explained the purpose and anonymous nature of the survey and that completion of the survey would be considered consent for study participation. The institutional review board at each participating institution approved the study.

The proportion of patients eligible for the 3 treatments of interest and the proportion of eligible patients who actually received the treatment were ascertained for each obstetrician using the Assessment of Perinatal Excellence (APEX) study[62] conducted by the *Eunice Kennedy Shriver* NICHD MFMU network. The APEX study was designed to develop quality measures for intrapartum obstetrical care and was approved by the institutional review board at each participating institution under a waiver of informed consent. Full details of the study design have been previously published.[62]

For this analysis, only patients who were delivered by one of the attending providers participating in the survey were included. For each treatment being studied, we identified all patients eligible to receive the treatment. We defined women eligible for receiving antenatal corticosteroids as those who delivered on the labor and delivery floor at less than 34 weeks' gestation and delivered 4 or more hours after admission. Women eligible for progesterone were thosewho delivered on the labor and delivery floor with a singleton pregnancy, had a history of a pretermbirth in a prior pregnancy, had at least 2 prenatal care visits, and had a pregnancy that was dated by a first- or second-trimester ultrasound or had assisted reproductive technology (as a proxy of receiving prenatal care before the third trimester). Among the women meeting these initial criteria for eligibility of progesterone, if progesterone was received, the previous pregnancy was assumed to have been spontaneous (the population eligible for progesterone); otherwise, the prenatal records were reabstracted to determine whether the previous preterm birth was spontaneous and to determine whether the patient received progesterone. Women eligible formagnesiumsulfatewere thosewithout gestational hypertension or preeclampsia (because they may receive magnesium sulfate for seizure prophylaxis), who delivered on the labor and delivery floor before 32 weeks of gestation, and who delivered 4 or more hours after admission. Within each subcohort of women eligible for the treatment under study, the primary outcomewas whether the patient received the treatment.

Data were analyzed at the patient level. The χ^2 test or the Fisher exact test, when appropriate, was used to assess univariate differences. Multivariable analysis was used to determine which patient, attending physician, and hospital factors were independently associated with the use of each of the interventions. Model selection and internal validation was performed using k-fold cross-validation in which the cohort was randomly divided into 10 equal parts and logistic regression models, using backward selection, were generated using every possible combination of 9 of the 10 sets.[63] Variables with $P < .05$ were retained, and each of the 10 subsamples was used for validation. All tests were 2 tailed and $P < .05$ was used to denote statistical significance. No imputation for missing data was performed and no adjustments were made for multiple comparisons.[64] Analyses were performed using SAS software (SAS Institute Inc, Cary, NC).

Results

The majority of hospitals that participated in this study were teaching hospitals (19 of 21) and located in an urban setting (19 urban, 2 suburban, and 0 rural of 21). Most of the hospitals had 24 hours a day, 7 days a week availability of maternal-fetal medicine specialists (19 of 21), in-house obstetric attending physician (laborist or otherwise) (18 of 21), neonatology services (17 of 21), and obstetric anesthesia services (18 of 21).

The median number of deliveries captured in APEX at the study hospitals was 4074. Of the 467 randomly selected providers, 443 remained eligible (ie, still delivering at the hospital at the time the survey was implemented), and 329 of the 443 (74%) completed the survey. Almost all invited maternal-fetal medicine specialists participated in the survey (92%), and the majority of obstetricians participated (70%). The 329 participating obstetricians performed 16,946 of the deliveries in the APEX observational cohort.

The patient characteristics of those cared for by physicians participating in the survey, compared with those whose physicians remained eligible but did not respond or refused participation in the survey, differed (Table 1). APEX patients included in this study were more ethnically diverse, more high risk, more likely to have been delivered by a maternal-fetal medicine specialist, more likely delivered at a teaching hospital, and more likely to have used magnesium sulfate if eligible for that treatment, compared with APEX patients delivered by an obstetrician who did not respond or refused participation in the survey.

Table 2 describes the providers' satisfaction with their knowledge about the treatment, their satisfaction with the evidence for each treatment, and the actual frequency of each treatment. More than 90% of the providers reported incorporating each of the treatments into practice. Actual use in eligible patients was high for antenatal corticosteroids (93%), but it was 71% for the magnesium sulfate and only 39% for the progesterone treatment. Provider satisfaction with quality of treatment evidence was 97% for antenatal corticosteroids, 82% for progesterone, and 57% for magnesium sulfate. Providers were asked whether barriers existed that prevented better use of the interventions. Seventy-six percent of providers reported barriers for progesterone, 30% for magnesium sulfate, and 17% for antenatal corticosteroids. Specific barriers cited are presented in Table 2.

Table 3 presents the frequency of eligible patients receiving each of the interventions by physician and hospital characteristics. Patients in hospitals with a maternal-fetal medicine specialist available 24 hours a day, 7 days a week were more likely to receive antenatal corticosteroid treatment.

Table 4 presents the frequency of receiving treatment, among eligible patients, by obstetrician provider attitudes regarding the treatments and hospital climate. Patients whose providers reported that they were more likely to use the intervention in practice had greater frequency of actual progesterone and magnesium sulfate treatment. Patients whose provider rated the quality of the evidence for a given practice as above average to excellent had greater frequency of treatment only for progesterone treatment. In addition, progesterone treatment was more common if providers were satisfied with their knowledge of the

intervention and was less common if the provider reported a barrier to hospital or pharmacy drug delivery.

Reported quality of the evidence and barriers to hospital or pharmacy drug delivery remained significantly associated with progesterone use in multivariable models (Table 5). Progesterone treatment was lowest among the uninsured/self-pay patients (Table 5). Maternal-fetal medicine coverage was no longer significantly associated with antenatal corticosteroid treatment in multivariable analysis (Table 5). Patients presenting with preterm premature rupture of membranes were slightly less likely to have received antenatal steroids, which is a treatment prescribed over a 24 hour period. None of the provider attitudes was associated with magnesium sulfate. Uninsured/self-pay patients were more likely to have received magnesium sulfate. No association with frequency of use was observed for TCI scores.

Comment

We evaluated factors that affect how clinical research is translated into practice in the setting of obstetrical care among MFMU Network hospitals. Our results suggest that the adoption of 3 evidence-based obstetrical interventions was found to be related to providers' assessment of evidence quality but not to the overall climate of innovation within a hospital as measured by the TCI.

For innovation to occur in a health care setting, providers need to be knowledgeable in evidence-based practice, satisfied with the evidence for a given practice, and capable of implementing a change.[65,66] The nature of the innovation also plays a key factor in its adoption.[3]

Physicians perceived some barriers to their patients receiving treatment, and these may also affect use of interventions. Difficulty in hospital/pharmacy drug delivery was significantly associated with the use of progesterone, which was used in only 39% of eligible patients. The cost of progesterone treatment, once approved by the Food and Drug Administration (FDA) in February 2011, rose substantially from $20 to $1500 per injection.[67] Outrage from the obstetrical community and patients forced the company to reduce its price and offer financial assistance programs.[68]

Additionally, the FDA issued a statement to facilitate the continued manufacturing of this product by compounding pharmacies in March 2011[69] but later cautioned against the purity and potency of compounding these products.[70] The physician survey was conducted between January 2011 and May 2011 in the midst of this confusion with drug availability and recommendations. Anecdotally, during chart review the nurse abstractors noted that many patients were offered progesterone but declined because of the cost and/or lack of coverage by their insurance. We acknowledge that the lack of clear proportion of those who declined treatment because of cost is a limitation of this study. The cost barrier is less likely to have affected the other 2 interventions that are usually accepted by payers as part of the inpatient care.

There was no difference in the frequency of implementation among large-delivery volume and small-delivery volume hospitals. This was surprising because hospital volume is reported to affect the hospital climate for innovation, with larger-delivery volumes thought to be more conducive to change.[71]

In contrast to studies in other disciplines, [58,61,72,73] we found that the hospital climate did not affect the use of different interventions. We are uncertain of the reasons for this discrepancy in results.

The maturity of these 3 interventions varies and may also contribute to their adoption and use. Antenatal steroid evidence is more than 10 years old, progesterone is 5-10 years old, and magnesium sulfate is less than 5 years old. More important than maturity, however, may be the quality of the evidence. The quality of the evidence as perceived by the providers was highest for antenatal steroids and lowest for magnesium sulfate, but this factor was significantly associated only with the use of progesterone.

In this study, eligibility for an intervention was defined in a way that did not take into consideration all clinical scenarios faced by the attending physician, and physicians' perceived eligibility, need, and likely benefit may be more refined at the individual patient level.

In the medical profession, leadership opinion and consensus statements affect widespread use. It is possible that NIH Consensus Conference Statements on utilization of obstetric interventions have a greater impact than press releases. The evidence for antenatal steroids was available since 1972, but its utilization increased significantly in the United States only after the NIH Consensus Conference Statement in 1994. Whereas there have been NICHD press releases and American College of Obstetricians and Gynecologists Committee Opinions for the use of progesterone to reduce preterm birth and magnesium sulfate for neuroprophylaxis, there were no NIH Consensus Conference Statements.

Because this is a survey study, it is affected by recall or responder bias. It may have been hard for some survey responders to recall information or to tell the truth about a controversial question. Surveys are not ideal for capturing exceptions and controversial issues as would a face-to-face interview or focus group, but the opposite can be true as well. Surveys have an inherent inflexible design because the questions are more general and may not apply to each provider. The strength of our survey study is being able to correlate the actual use of the 3 interventions by the same providers who responded to the survey. However, use of these 3 interventions was specific to the MFMU Network, and the majority of providers that participated in the survey were MFM specialists.

Clinical implications

This study demonstrates some factors that can facilitate adoption of evidence-based interventions, but many questions remain. We recommend continued efforts to evaluate the evidence, to disseminate the evidence superlatively such as through NIH Consensus Statements, and to remove barriers to implementation.

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TABLE 1

Patient and delivery characteristics by provider survey participation

Characteristics of the study population	Delivered by an obstetrician who participated in the survey (n = 16,946), n (%)	Delivered by an obstetrician who refused participation in the survey (n = 4525), n (%)	*P* value
Age, y			< .001
<20	1355 (8.0)	267 (5.9)	
20–34.9	12,728 (75.1)	3617 (79.9)	
≥35	2863 (16.9)	641 (14.2)	
Race/ethnicity[a]			< .001
Non-Hispanic white	6814 (40.2)	3025 (66.9)	
Non-Hispanic black	3893 (23.0)	539 (11.9)	
Non-Hispanic Asian	1067 (6.3)	195 (4.3)	
Hispanic	4066 (24.0)	625 (13.8)	
Other or not documented	1106 (6.5)	141 (3.1)	
Insurance status			< .001
Uninsured or self-pay	1983 (11.8)	315 (7.0)	
Government assisted	7383 (43.7)	1155 (25.6)	
Private	7513 (44.5)	3043 (67.4)	
Prenatal care	15,642 (97.7)	4273 (98.6)	< .001
Multiple gestation	476 (2.8)	98 (2.2)	.02
Premature rupture of the membranes	917 (5.5)	171 (3.8)	< .001
Eligible for ACS[b]	500 (3.0)	96 (2.1)	.003
ACS use among those eligible for ACS	463 (92.6)	84 (87.5)	.10
Eligible for PROG[c]	753 (4.4)	*e*	
Eligible for MG[d]	181 (1.1)	35 (0.8)	.08
MG use among those eligible for MG	129 (71.3)	13 (37.1)	< .001
Gestational age at delivery, wks (first born in multifetal)			< 001
23^0 to 33^6	859 (5.1)	146 (3.2)	
34^0 to 36^6	1448 (8.5)	343 (7.6)	
37^0 to 41^6	14,600 (86.2)	4029 (89.0)	
≥42^0	39 (0.2)	7 (0.2)	
Specialty of patient's attending at delivery			< .001
General obstetrics	12,717 (75.0)	4392 (97.1)	
Maternal-fetal medicine	4229 (25.0)	133 (2.9)	
Years since patient's attending physician at delivery graduated medical or midwifery school			< .001
0–9.9 (includes no attending at delivery)	3443 (20.6)	499 (11.0)	
10–14.9	3553 (21.3)	657 (14.5)	
15–19.9	3225 (19.3)	804 (17.8)	

Characteristics of the study population	Delivered by an obstetrician who participated in the survey (n = 16,946), n (%)	Delivered by an obstetrician who refused participation in the survey (n = 4525), n (%)	*P* value
20–24.9	2580 (15.5)	779 (17.2)	
≥25	3878 (23.3)	1786 (39.5)	
Maternal-fetal medicine availability 24/7	14,045 (82.9)	3671 (81.1)	.006
Obstetrics residents on labor and delivery	16,413 (96.9)	3788 (83.7)	< .001

ACS, antenatal corticosteroids for fetal lung maturity; *MG*, magnesium sulfate for fetal neuroprotection; *PROG*, progesterone for prevention of preterm delivery.

[a] Race/ethnicity was reported in the chart;

[b] Patients eligible for antenatal corticosteroid for fetal lung maturity were those who delivered in the labor and delivery department before 34 weeks of gestation and delivered 4 or more hours after admission;

[c] Patients eligible for progesterone for the prevention of preterm birth were those who delivered in the labor and delivery department with a singleton pregnancy, with a history of a prior spontaneous preterm delivery, who had at least 2 prenatal care visits, and whose pregnancy was dated by a first- or second-trimester ultrasound or had assisted reproductive tech- nology;

[d] Patients eligible for magnesium sulfate for neuroprotection were those who delivered in the labor and delivery department before 32 weeks of gestation, did not have gestational hypertension or preeclampsia, and delivered 4 or more hours after admission;

[e] Not determined in this group.

TABLE 2

Provider attitudes by intervention (n = 16,946)

Variable	Antenatal corticosteroid for fetal lung maturity, n (%)	Progesterone for prevention of preterm birth, n (%)	Magnesium sulfate for neuroprotection, n (%)
Provider stated that they prescribe intervention in practice (intent)	16,812 (99.2)	16,375 (96.6)	15,490 (91.4)
Provider was satisfied with their knowledge of the intervention	16,373 (96.6)	14,292 (84.4)	11,126 (65.7)
Provider rated the quality of the evidence for the intervention as above average to excellent	16,446 (97.1)	13,788 (81.6)	9528 (57.4)
Provider perceived barriers to their patients' receiving the intervention	2875 (17.1)	12,913 (76.4)	4996 (30.1)
Financial	142 (0.8)	7408 (43.8)	100 (0.6)
Fear of birth defects	536 (3.2)	1430 (8.5)	236 (1.4)
Fear of side effects	*a*	*a*	3945 (23.7)
Fear of injections	1440 (8.6)	6929 (41.0)	*a*
Difficulty with hospital or pharmacy drug delivery	272 (1.6)	4185 (24.8)	74 (0.4)
Difficulty arranging injection	*a*	4250 (25.1)	*a*
Poor compliance	531 (3.2)	3588 (21.2)	*a*
Poor patient understanding of drug benefits	791 (4.7)	2322 (13.7)	2184 (13.1)
Actual frequency of treatment in patients eligible for the treatment (practice)	463 (92.6)	292 (38.8)	129 (71.3)

[a]The survey did not ascertain this information for this particular intervention.

TABLE 3

Receiving treatment by characteristics of the provider and hospital

Variable	Antenatal corticosteroid for fetal lung maturity (n = 500 eligible),[a] n (%)	Progesterone for prevention of preterm birth (n = 753 eligible),[b] n (%)	Magnesium sulfate for neuroprotection (n = 181 eligible),[c] n (%)
Hospital annual delivery volume			
Tertile 1	225 (92.6)	110 (36.2)	53 (68.0)
Tertile 2	162 (92.6)	118 (44.7)	55 (72.4)
Tertile 3	76 (92.7)	64 (34.6)	21 (77.8)
Hospital availability of maternal-fetal medicine 24/7			
No	31 (83.8)[d]	48 (47.1)	8 (61.5)
Yes	432 (93.3)[d]	244 (37.5)	121 (72.0)
Attending specialty			
General obstetrics	221 (91.3)	179 (38.2)	60 (69.8)
Maternal-fetal medicine	242 (93.8)	113 (39.8)	69 (72.6)
Attending years since graduated medical school			
0–9.9 (includes no attending at delivery)	102 (93.6)[d]	56 (38.9)	31 (73.8)
10–14.9	113 (96.6)[d]	70 (40.9)	32 (65.3)
15–19.9	94 (94.0)[d]	50 (36.5)	23 (74.2)
20–24.9	37 (78.7)[d]	35 (35.4)	8 (72.7)
≥25	115 (92.0)[d]	77 (40.3)	34 (72.3)

[a] Patients eligible for antenatal corticosteroid for fetal lung maturity were those who delivered in the labor and delivery department before 34 weeks of gestation and delivered 4 or more hours after admission;

[b] Patients eligible for progesterone for the prevention of preterm birth were those who delivered in the labor and delivery department with a singleton pregnancy, with a history of a prior spontaneous preterm delivery, who had at least 2 prenatal care visits, and whose pregnancy was dated by a first- or second-trimester ultrasound or had assisted reproductive technology;

[c] Patients eligible for magnesium sulfate for neuroprotection were those who delivered in the labor and delivery department before 32 weeks of gestation, did not have gestational hypertension or pre-eclampsia, and delivered 4 or more hours after admission;

[d] Statistically significant χ^2 or Fisher exact test ($P < .05$).

TABLE 4

Receiving treatment by provider attitudes and hospital climate

Variable	Antenatal corticosteroid for fetal lung maturity (n = 500 eligible),[a] n (%)	Progesterone for prevention of preterm birth (n = 753 eligible),[b] n (%)	Magnesium sulfate for neuroprotection (n = 181 eligible),[c] n (%)
Provider stated that they prescribe intervention in practice (intent)			
No	2 (66.7)	3 (10.3)[d]	3 (37.5)[d]
Yes	461 (92.8)	289 (39.9)[d]	126 (72.8)[d]
Provider was satisfied with their knowledge of the intervention			
No	27 (100.0)	29 (28.4)[d]	30 (65.2)
Yes	436 (92.2)	263 (40.5)[d]	99 (73.3)
Provider rated the quality of the evidence for the intervention as above average to excellent			
No	7 (87.5)	35 (24.5)[d]	53 (69.7)
Yes	456 (92.7)	257 (42.3)[d]	75 (72.1)
Provider perceived barriers to their patients' receiving the intervention			
No	398 (92.1)	56 (35.2)	93 (73.2)
Yes	63 (95.5)	236 (39.9)	33 (66.0)
Financial			
No	461 (92.6)	143 (36.3)	125 (71.0)
Yes	0 (0.0)	149 (41.9)	1 (100.0)
Fear of birth defects			
No	457 (92.7)	263 (38.0)	126 (71.2)
Yes	4 (80.0)	29 (50.9)	0 (0.0)
Fear of side effects			
No	*e*	*e*	99 (73.3)
Yes	*e*	*e*	27 (64.3)
Fear of injections			
No	439 (92.4)	173 (40.9)	*e*
Yes	22 (95.7)	119 (36.4)	*e*
Difficulty with hospital or pharmacy drug delivery			
No	454 (92.7)	235 (41.5)[d]	126 (71.2)
Yes	7 (87.5)	57 (31.0)[d]	0 (0.0)
Difficulty arranging injection			
No	*e*	222 (40.3)	*e*
Yes	*e*	70 (35.2)	*e*
Poor compliance			

Variable	Antenatal corticosteroid for fetal lung maturity (n = 500 eligible),[a] n (%)	Progesterone for prevention of preterm birth (n = 753 eligible),[b] n (%)	Magnesium sulfate for neuroprotection (n = 181 eligible),[c] n (%)
No	440 (92.2)	231 (39.5)	*e*
Yes	21 (100.0)	61 (37.0)	*e*
Poor patient understanding of drug benefits			
No	445 (92.5)	254 (39.6)	112 (70.4)
Yes	16 (94.1)	38 (34.9)	14 (77.8)
Team Climate Inventory score			
Quartile 1	90 (93.8)	56 (33.7)	23 (69.7)
Quartile 2	104 (95.4)	81 (44.8)	26 (63.4)
Quartile 3	127 (90.7)	73 (39.9)	40 (76.9)
Quartile 4	120 (90.2)	72 (38.3)	33 (71.7)

[a] Patients eligible for antenatal corticosteroid for fetal lung maturity were those who delivered in the labor and delivery department before 34 weeks of gestation and delivered 4 or more hours after admission;

[b] Patients eligible for progesterone for the prevention of preterm birth were those who delivered in the labor and delivery department with a singleton pregnancy, with a history of a prior spontaneous preterm delivery, who had at least 2 prenatal care visits, and whose pregnancy was dated by a first- or second-trimester ultrasound or had assisted reproductive technology;

[c] Patients eligible for magnesium sulfate for neuroprotection were those who delivered in the labor and delivery department before 32 weeks of gestation, did not have gestational hypertension or preeclampsia, and delivered 4 or more hours after admission;

[d] Statistically significant χ^2 or Fisher exact test ($P < .05$);

[e] The survey did not ascertain this information for this particular intervention.

TABLE 5

Multivariable models for factors associated with receiving treatment

Variable	Antenatal corticosteroid for fetal lung maturity (n = 500 eligible),[a] RR (CI)	Progesterone for prevention of preterm birth (n = 753 eligible),[b] RR (CI)	Magnesium sulfate for neuroprotection (n = 181 eligible),[c] RR (CI)
Insurance status			
Uninsured or self-pay		0.27 (0.14–0.51)	1.34 (1.03–1.75)
Government assisted		0.72 (0.52–1.01)	1.20 (0.97–1.49)
Private		1.00 (referent)	1.00 (referent)
Preterm premature rupture of the membranes	0.93 (0.88–0.99)		
Attending years since graduated medical school			
0–9.9 (includes no attending at delivery)	1.00 (referent)		
10–14.9	1.02 (0.97–1.08)		
15–19.9	1.01 (0.95–1.07)		
20–24.9	0.84 (0.72–0.98)		
≥25	0.99 (0.92–1.05)		
Provider rated the quality of the evidence for the intervention as above average to excellent		2.38 (1.56–3.63)	
Difficulty with hospital or pharmacy drug delivery		0.57 (0.40–0.83)	

CI, confidence interval; *RR*, relative risk.

[a] Patients eligible for antenatal corticosteroid for fetal lung maturity were those who delivered in the labor and delivery department before 34 weeks of gestation and delivered 4 or more hours after admission;

[b] Patients eligible for progesterone for the prevention of preterm birth were those who delivered in the labor and delivery department with a singleton pregnancy, with a history of a prior spontaneous preterm delivery, who had at least 2 prenatal care visits, and whose pregnancy was dated by a first or second trimester ultrasound or had assisted reproductive technology;

[c] Patients eligible for magnesium sulfate for neuroprotection were those who delivered in the labor and delivery department before 32 weeks of gestation, did not have gestational hypertension or pre-eclampsia, and delivered 4 or more hours after admission.